#442

RS-12B

EUV FLUX REFERENCE SPECTRUM

FOR SOLAR UV BELOW 2000 ANGSTRUMS

Table of Contents

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP's).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents To find associated documents you will need to know the document ID number and then click here. http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

REQ AGENT	RAND NO	ACQ AGENT
VJP	RD2465	RWP

RS-12B
EUV FLUX REFERENCE SPECTRUM
FOR SOLAR UV BELOW 2000 ANGSTROMS

This data set catalog consists of 1 data tape. The tape is 6250 bpi, ASCII, 9 track with 4 files of data. The tape was created on a SIGMA 9 computer. The time, 'D' and 'C' number are as follows:

D #	C #	Time Span
D-33865	C-20602	April 23, 1974

COMPUTER SCIENCES CORPORATION
SYSTEM SCIENCES DIVISION (301) 589-1545
8728 COLESVILLE ROAD · SILVER SPRING, MARYLAND 20910

July 10, 1978

National Space Sciences Data Center
Code 601.0
NASA, GSFC
Greenbelt, Md.

Dear Dr. Wende:

Dr. Hans Hinteregger (Principal Investigator, Extreme Ultraviolet Spectrophotomes on the Atmosphere Explorer satellite series) has requested that I send to your data center the following materials:

A copy of his recent paper entitled "Aeronomical Reference Spectrum for Solar UV Below 2000 A".

A magnetic tape containing both the R74113 and F74113 spectra.

These are enclosed with this letter, and a brief set of technical notes follows.

The card deck has been interpreted and contains 72 columns of data followed by the 4 character literal 'F74:' and a 4 digit sequence number ranging from 0000 to 1997. The internal format of the data field has been given in the enclosed paper by Dr. Hinteregger.

The magnetic tape has no label or header records of any kind. It was written at 800 BPI, has 9 tracks, and contains 4 files. These are separated by single end-of-file marks and followed by 4 such marks to denote the end of the tape. The first two files are the F74113 and R74113 spectra respectively, and the last two are another copy of these two files, in the same order. Within each file, the logical record length is the same as the physical record length, and each record contains 72 EBCDIC characters. The internal format of each record is specified in the enclosed paper by Dr. Hinteregger. This tape was written on the Honeywell Sigma 9 computer associated with the Atmosphere Explorer project located at the NASA Goddard Space Flight Center, Greenbelt, Maryland.

If I can be of assistance, please write or call me at Computer Sciences Corporation [(301) 589-1545, extension 651].

Sincerely yours,

Leslie Chaikin

Leslie Chaikin

LC:ms

Enclosures

1978 COSPAR Working Group 4 Open Meeting (IV. A.2.5, 7 June)
~~[submitted for publication in J.G.R.]~~ RS-12B
[Preprint copy; slightly edited copy accepted for publication in JGR

Aeronomical Reference Spectrum for Solar UV Below 2000 Å

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ABSTRACT

The solar reference spectrum named R74113 announced at the 1975 IAGA symposium in Grenoble refers to the solar conditions of April 23, 1974 and covers the wavelength range 14 to 2000 Å. The fluxes for R74113 between 250 and 1940 Å were based on a preliminary evaluation of data obtained from a rocket experiment flown on April 23, 1974. The fluxes outside of the wavelength range covered by the rocket experiment were estimated values for the solar condition of April 23, 1974. This reference spectrum has been revised because of refined evaluation of the rocket data and detailed experience gained from many scans of the solar spectrum for the entire wavelength range from 140 to 1950 Å obtained from the EUVS experiment on the AE-E satellite. Although numerous changes have been made in the revised spectrum named F74113, summarized here, these changes have only a small effect on aeronomical calculations that have been based on the original reference spectrum.

A solar EUV reference spectrum for the wavelength region from 15 to 2000 Å was announced and summarized by Hinteregger [1976] at the 1975 IAGA symposium in Grenoble. Named R74113, this reference spectrum has been used in various aeronomical studies and also in the evaluation of data obtained from the extreme ultraviolet spectrometer (EUVS) experiments [Hinteregger et al., 1973, Hinteregger, 1976] on the Atmosphere Explorer (AE) satellites.

The absolute fluxes for the part of R74113 in the wavelength range between 250 and 1940 Å were obtained from a rocket measurement of full-disk solar fluxes conducted on April 23, 1974 [Heroux and Higgins, 1977]. On the same day, the EUVS experiment on AE-C also recorded solar fluxes over much of this wavelength region so that the rocket values of absolute flux could be used to establish absolute calibration factors for the EUVS experiment [Hinteregger, 1976; Hinteregger et al., 1977]. The fluxes of R74113 outside of the region 250-1950 Å were estimated values that were included to establish an extended reference spectrum for use in aeronomical calculations. To extend its application to computations requiring data having high spectral resolution, some wavelength regions of R74113 included a listing of closely spaced solar emission lines having spacings less than the instrumental resolution of the spectrometer. For those cases, only the sum of the fluxes within the instrumental bandwidth of the rocket spectrometer was measured, and, therefore, the intensity ratios of lines listed within that bandwidth are estimates.

A summary of R74113 was published in tabular form by Hinteregger [1976] and the detailed reference spectrum kept on line in the AE-dedicated computer (Xerox Sigma 9) at NASA Goddard Space Flight Center for use by the AE team of investigators. The detailed spectrum was also included in a first selection of EUVS data on magnetic tape released to the National Space Science Data Center (NSSDC) for public use. As noted by Hinteregger [1976], the fluxes listed in R74113 were based on a preliminary evaluation of the rocket data of April 23, 1974. Subsequent editing of R74113 data was made after further analysis of the rocket results that was based in part on measurements of the entire solar spectrum between 140 and 1850 Å obtained from the EUVS experiment on AE-E. To avoid confusion, the revision of R74113 is identified as F74113. Records of both data sets on magnetic tape are being forwarded to NSSDC and to National Geophysical and Solar-Terrestrial Data Center in Boulder (collocated with World Data Center A for Solar-Terrestrial Physics).

The AE-E satellite data have helped clarify uncertainties in the rocket data. These uncertainties are associated with low signal-count samples of both weak emission lines and the continua, line identifications because of overlapping orders, and the determination of the background under the continua. The data averages of the AE-E scans of the HI and HeI continua and the H Ly-α wings, for example, have far greater statistical significance than that of the rocket scan. The use of the AE-E scans has led to considerable improvements in the estimated flux values given in the revised reference spectrum F74113.

Like R74113, F74113 gives wavelengths in Å, fluxes in units of 10^6 photons $cm^{-2}s^{-1}$ (10^{10} ph m^{-2} s^{-1}), and the line identifications for many solar emission lines in the wavelength range 15 to 2000 Å and for continua for 1 Å intervals in the range 400 to 2000 Å. The 8-character identification of each wavelength record*) of F74113 has now been written in a consistent

*) The computer file of the reference spectrum F74113, provided on magnetic tape, has been created in EBDCDIC format and consists of 1957 wavelength-ordered records each of which is written in FORTRAN FORMAT (1X, F7.2, F8.1, 2A4, 1X, A1) followed by a record flagging the end of actual data (zero in wavelength column), an identifying record (1X, 78115 1957) and explanatory text (39 records of 16A4) at the end of the file. This format has been selected to allow the simplest possible conversion for use on other computers, direct print-out without requiring a read program, or direct conversion to a set of standard punched cards (1998 cards total). The previously released reference spectrum, R74113, has essentially the same format (1X, F7.2, F8.1, 2A4) for 1959 wavelength entries, followed by an end mark (zero in wavelength column) and a correspondingly different identification record (1X, 75036 1959), which is not followed by any text records. The magnetic tape being forwarded to NSSDC and WDC-A for Solar-Terrestrial Physics contains both R74113 and the new reference spectrum F74113, to facilitate detailed comparisons by users.

format, and this identification is followed by a one-character indicator which refers to blends (B) involving lines other than the species listed in the identification column, groups (G) of lines of the same species but including lines other than those shown in the wavelength column, and questionable identifications (?). If none of these three cases apply, this indicator is left blank.

A summary of F74113 is given here in Table 1 for 50 Å intervals of wavelengths between 50 and 1940 Å. Only the most prominent solar emission lines are listed individually. Various intense solar emission lines of the highly ionized atomic species situated within the approximate spectral region 170 to 210 Å are not shown in Table 1, because rocket calibration data were not available. However, estimated intensities for these lines have been included again in the revised data of F74113 on magnetic tape. The intensities for the range of wavelengths between 250 and 1940 Å, which are based on the rocket measurements of April 23, 1974, have estimated errors of ±30% between 250 and 1220 Å and 15% between 1240 and 1940 Å. The calibration procedures used for these two wavelength regions have been discussed by Heroux et al., [1974] and Heroux and Swirbalus [1976]. The intensities for the spectral region below 250 Å are adjusted estimates based on a combination of measurements from earlier AFGL (formerly AFCRL) rocket experiments under conditions of $F_{10.7}$ = 101 [Manson, 1976] and $F_{10.7}$ = 120 [Heroux et al., 1974] and from many AE satellite spectra obtained during 1974-1976. The emission lines of the species FeIX through FeXIV between about 170 and 210 Å are particularly intense. A comparison of the two sets of previous rocket data indicate that the intensities of the lines of FeIX, X, and XI are nearly identical for $F_{10.7}$ of 101 and 120, while those of FeXII, XIII, and XIV clearly vary with $F_{10.7}$. Most of these emission lines were observed in first order in the EUVS experiment on AE-C and also in second order in the rocket experiment of April 23, 1974 when $F_{10.7}$ was 74. Ratios observed in the intensities of the active lines relative to those of the less active lines of FeIX, X, and XI were then used to estimate the line intensities of the reference spectrum for April 23, 1974 for wavelengths less than 250 Å.

Although the number of revisions applied to R74113 to obtain the new reference spectrum F74113 is large, the original and revised fluxes are in fairly good agreement when summed over large wavelength intervals. Table 2 compares the ratio of fluxes F74113/R74113 for 100 Å intervals of wavelength. The ratios seen in Table 2 that are conspiciously different from unity have little aeronomical significance. The large ratio R = 1.68 for the interval 650-750 Å results from an error in the previous flux value of the 703.36 Å line of OIII (this line alone accounts for 60% of the flux in the interval 650-750 Å). The decreases in flux of approximately 30% for the intervals 850-950 Å and 1050-1150 Å reflect revisions of intensities of the HI continuum and the wings of H-Lyman α, respectively. Therefore, previously published aeronomical calculations that have been based on R74113 should need no revision. On the other hand, we do recommend the use of the revised spectrum F74113 for future studies.

The present reference spectrum is recommended as a good model of solar EUV fluxes only if proper attention is given to certain restrictions:

1) F74113 appears to be readily applicable only to those days of 1974 for which the 27-day variation of solar EUV was near its minimum and the associated value of $F_{10.7}$ close to 70. In general, these days of 1974 may be said to reflect conditions on the visible solar disk of very low solar activity. AE-C observations suggest that the EUV fluxes for those days remained essentially constant throughout the year [Hinteregger, 1976; Hinteregger et al., 1977]. However, it should be noted that several consecutive days without sun spots ($R_z = 0$) occurred only during the following two years, 1975-76, when the transition from solar Cycle 20 to the new Cycle 21 occurred. AE-C observations made during 1975-76 suggest the occurrence of an EUV minimum in April 1975 when the intensities of low-excitation solar-EUV emissions such as the 584 Å HeI line are estimated to be about 15% below the reference level of April 23, 1974 given by F74113 [Hinteregger, 1977]. The fluxes of F74113, therefore serve only as an approximate EUV model of solar minimum. A clear distinction of the "solar minimum" is difficult because of the complex history of solar activity during the decline of Cycle 20 and the rise of Cycle 21. The longest stretch of days of a spotless solar disk actually occurred for the month of July 1976 which is designated as the formal beginning of Cycle 21. Since EUV fluxes for that month apparently were not only higher than the 1975-minimum but also significantly higher than the levels given by F74113 for April 23, 1974 ($R_z = 18$), the month of July 1976 reflects conditions of solar minimum for the new Cycle 21 only, but not for Cycle 20.

2) For aeronomical model calculations for phases within the past solar Cycle 20, we do not suggest procedures to scale EUV fluxes with respect to conventional solar indices such as $F_{10.7}$. Occasional rocket measurements made by Heroux and Higgins [1977] during a 7-year period of solar Cycle 20 indicate a surprisingly constant value of EUV fluxes in the region 300 to 1220 Å for a range of $F_{10.7}$ extending from 70 to 188. Because of the limited number of measurements made, it is possible that the EUV fluxes varied by more than the 10% indicated by their measurements, but it appears unlikely that the EUV flux variations exceeded 30%.

3) For aeronomical model calculations for periods outside of the past solar Cycle 20, it does not appear to be appropriate to use the revised EUV flux model F74113. For example, the previously mentioned constancy of EUV variations relative to variations of $F_{10.7}$ [Heroux and Higgins, 1977] of R_z, which is peculiar to Cycle 20, is in striking contrast to AE-satellite observations for Cycle 21, where the amplitudes of relative EUV variations observed to date are nearly as large as those of the associated variations in $F_{10.7}$ and have a base level of quiet-disk EUV fluxes well above those given by F74113 (paper presented at the 1977 IAGA symposium by Hinteregger, to be published elsewhere).

ACKNOWLEDGMENTS

We thank J.E. Higgins and J.E. Manson, who contributed significantly to the acquisition of much of the rocket and satellite data, and K. Fukui for assistance in the revision of the flux table. Evaluation of the satellite scan data and associated corrections was carried out by B.R. Gilson and L.M. Chaikin of Computer Sciences Corporation, Silver Spring, MD.

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Table 1. Solar UV Reference Spectrum F74113 for April 23, 1974

Wavelength, * Å	Ion	Intensity Incident on Earth 10^{9} ph $cm^{-2}s^{-1}$	10^{-3} erg $cm^{-2}s^{-1}$
50-100		0.42	113
100-150		0.15	24
150-200		2.4	271
200-250		1.6	139
256.3	HeII, SiX	0.46	36
284.15	FeXV	0.21	15
250-300		2.3	166
303.78	HeII	6.9	450
300-350		8.7	530
368.07	MgIX	0.65	35
350-400		1.02	55
400-450		0.39	18
465.22	NeVII	0.29	12.4
450-500		0.59	24
500-550		0.49	19
554.37§	OIV	0.72	26
584.33	HeI	1.3	44
550-600		2.2	76
609.76	MgX	0.53	17
629.73	OV	1.6	50
600-650		2.3	74
650-700		0.11	3.2
703.36+	OIII	0.36	10
700-750		0.49	13.4
765.15	NIV	0.17	4.4
770.41	NeVIII	0.26	6.7
789.36§	OIV	0.68	10.8
750-800		1.8	46
800-850		1.5	35
850-900		3.5	78
900-950		3.3	71
977.02	CIII	4.4	89
950-1000		6.0	121
1025.72	HI	3.5	68
1031.91	OVI	2.1	40
1000-1050		8.1	156

TABLE 1. (Continued)

Wavelength, * Å	Ion	Intensity Incident on Earth 10^{9} ph $cm^{-2}s^{-1}$	10^{-3} erg $cm^{-2}s^{-1}$
1050-1100		2.9	52
1100-1150		.91	16
1150-1200		4.4	74
1215.67	HI	251	4100
1200-1250		259	4200
1250-1300		4.1	64
1302.17	OI	1.10	17
1304.86	OI	1.13	17
1306.03	OI	1.23	19
1334.53	CII	1.8	27
1335.70	CII	2.5	37
1300-1350		12.4	186
1393.76	SiIV	1.3	19
1350-1400		7.4	107
1402.77	SiIV	.91	12.9
1400-1450		10.4	145
1450-1500		16.2	218
1548.19	CIV	3.8	49
1500-1550		29	381
1550.77	CIV	1.9	25
1561.0§	CI	2.5	32
1550-1600		40	503
1600-1650		56	681
1657.2§	CI	8.5	102
1650-1700		130	1540
1700-1750		225	2590
1750-1800		357	3990
1808.01	SiII	9.2	101
1816.93		14.2	155
1816.45		5.5	60
1800-1850		604	6570
1850-1900		777	8230
1900-1940		829	8580

* From Kelly and Palumbo [1973] except as indicated

§ From averaged weighted energy levels of the multiplet. Integrated intensity for the multiplet is given.

Table 2. Comparison of revised reference spectrum, F74113, with the preliminary R74113

Wavelength Range Å	Photon Fluxes 10^{9} ph $cm^{-2}s^{-1}$ F74113	R74113	Ratio F/R	Energy Fluxes 10^{-3} erg $cm^{-2}s^{-1}$ F74113	R74113	Ratio F/R	Number of Entries F	R
50 - 150	0.55	.61	0.91	129	141	0.92	185	185
150 - 250	3.93	4.73	0.83	398	486	0.82	93	95
250 - 350	11.0	10.8	1.02	736	732	1.01	47	47
350 - 450	1.35	1.38	0.98	70	73	0.96	56	55
450 - 550	0.99	1.14	0.87	40	46	0.87	63	66
550 - 650	4.67	4.55	1.03	155	151	1.03	54	56
650 - 750	0.62	0.37	1.68	18	10	1.68	105	110
750 - 850	3.45	3.99	0.87	85	98	0.87	113	112
850 - 950	6.57	9.55	0.69	145	212	0.69	109	108
950 -1050	13.9	13.1	1.06	275	259	1.06	110	108
1050 -1150	3.75	4.95	0.76	68	89	0.76	105	106
1150 -1250	264	283	0.93	4312	4622	0.93	105	105
1250 -1350	16.5	19.7	0.84	250	298	0.84	109	108
1350 -1450	17.8	18.7	0.95	252	264	0.95	104	103
1450 -1550	45.4	52.6	0.86	599	688	0.87	104	103
1550 -1650	95.5	104	0.91	1182	1295	0.91	108	104
1650 -1750	355	363	0.98	4135	4221	0.98	105	106
1750 -1850	961	924	1.04	10564	10164	1.04	103	103
1850 -1950	1862	1872	0.99	19411	19516	0.99	100	100

DUMP OF TAPE X-409

INPUT TAPE X-409 ON MS2
DATA INPUT H9 NF 4 FL 1 1 1 SR 4 1 1 SR 4 LAST 1

FILE 1 RECORD 1 LENGTH 72BYTES

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(40) 40404040 40404040 40404040 40404040 40404040 40404040 40404040 40404040

FILE 1 RECORD 1998 LENGTH 72BYTES

(0) 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C
(40) 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C5C5C 5C5C4040 40404040 40404040

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
1	1998	1998	72	0	0	0	0	0	0

FILE 4 RECORD 1 LENGTH 72BYTES

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(40) 40404040 40404040 40404040 40404040 40404040 40404040 40404040 40404040

FILE 4 RECORD 1981 LENGTH 72BYTES

(0) 40404BF1 F44BF2F5 40404040 40404BF1 F9F5F940 40404040 40404040 40404040 40404040 40404040
(40) 40404040 40404040 40404040 40404040 40404040 40404040 40404040 40404040

FILE	INPUT RECS.	DATA RECORDS INPUT	MAX. SIZE	READ ERROR SUMMARY PERM	ZERO B	SHORT	UNDEF.	INPUT RETRIES #RECS.	TOTAL#
4	1981	1982	72	0	0	0	0	0	0

EOJ DUMP STOPPED AFTER FILE 4 # OF PERMANENT READ ERRORS 0

START TIME 05/15/79 14:32:32 STOP TIME 05/15/79 14:34:44

$$
$ASS IN MS4 OUT MS2